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FIPS PUB 178

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATION

VIDEO TELECONFERENCING SERVICES AT 56 TO 1,920 KB/S

CATEGORY: TELECOMMUNICATIONS STANDARD

SUBCATEGORY: VIDEO TELECONFERENCING

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Foreword

The Federal Information Processing Standards Publication Series of the National Institute of Standards and Technology (NIST) is the official publication relating to standards and guidelines adopted and promulgated under the provisions of Section 111(d) of the Federal Property and Administrative Services Act of 1949 as amended by the Computer Security Act of 1987, Public Law 100-235. These mandates have given the Secretary of Commerce and NIST important responsibilities for improving the utilization and management of computer and related telecommunications systems in the Federal Government. The NIST through its Computer Systems Laboratory provides leadership, technical guidance, and coordination of Government efforts in the development of standards and guidelines in these areas.

Comments concerning Federal Information Processing Standards Publications are welcomed and should be addressed to the Director, Computer Systems Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899.

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Abstract

This standard, by adoption of International Telegraph and Telephone Consultative Committee (CCITT) Recommendations H.320, H.221, H.242, H.261, and H.230, defines the specifications for video teleconferencing and video telephony systems.

This document provides Federal departments and agencies a comprehensive description of the interoperability criteria for audiovisual systems used in video teleconferencing and videophone applications.

Key words: communications systems; Federal Information Processing Standard (FIPS); telecommunications; video teleconferencing; video telephony.

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Federal Information Processing Standards Publications (FIPS PUBS) are issued by the National Institute of Standards and Technology (NIST) after approval by the Secretary of Commerce pursuant to section 111 (d) of the Federal Property and Administrative Services Act of 1949 as amended by the Computer Security Act of 1987, Public Law 100-235.

1. **Name of Standard.** Video Teleconferencing Services at 56 to 1,920 kb/s (FIPS PUB 178).
2. **Category.** Telecommunications Standards, Video Teleconferencing.
3. **Explanation.** This standard, by adoption of International Telegraph and Telephone Consultative Committee (CCITT) Recommendations H.320, H.221, H.242, H.261, and H.230, defines the specifications for video teleconferencing and video telephony systems.
This document provides Federal departments and agencies a comprehensive description of the interoperability criteria for audiovisual systems used in video teleconferencing and videophone applications.
4. **Approving Authority.** Secretary of Commerce.
5. **Maintenance Agency.** National Communications System, Office of Technology and Standards.
6. **Cross Index.** The recommendations listed below are adopted and referenced by this standard.
 - a. CCITT Recommendation H.320, Narrow-band Visual Telephone Systems and Terminal Equipment, 1990.
 - b. CCITT Recommendation H.221, Frame Structure for a 64 to 1,920 kbit/s Channel in Audiovisual Teleservices, 1990.
 - c. CCITT Recommendation H.242, System for Establishing Communication Between Audiovisual Terminals Using Digital Channels up to 2 Mbit/s, 1990.
 - d. CCITT Recommendation H.261, Video Codec for Audiovisual Services at $p \times 64$ kbit/s, 1990.
 - e. CCITT Recommendation H.230, Frame Synchronous Control and Indication Signals for Audiovisual Systems, 1990.
7. **Related Documents.**
 - a. Federal Information Resources Management Regulations subpart 201-20.303, Standards, and subpart 201-39.1002, Federal Standards.
The standards listed below are for information only.
 - b. ANSI T1.306-1990, American National Standard for Telecommunications—Digital Processing of Audio Signals—Algorithm and Line Format for Transmission of 7-Khz Audio Signals at 64/56 kbit/s
 - c. ANSI T1.314-1991, American National Standard for Telecommunications—Video Coder/Decoder for Audiovisual Services at 56 to 1,536 kbit/s
 - d. CCITT Proposed Recommendation AV.253, Audio coding at 24/32 kbit/s
 - e. CCITT Recommendation G.711, Pulse Code Modulation (PCM) of Voice Frequencies, (1989)
 - f. CCITT Recommendation G.722, 7 kHz Audio-coding within 64 kbit/s, (1989)
 - g. CCITT Recommendation G.725, System Aspects for the Use of the 7 kHz Audio Codec within 64 kbit/s, (1989)
 - h. Proposed CCITT Recommendation G.728, Speech coding at 16 kbit/s

- i. CCITT Recommendation G.821, Error Performance of an International Digital Connection Forming Part of an Integrated Services Digital Network, (1989)
- j. CCITT Recommendation H.200, Framework for Recommendations for Audiovisual Services, (1989)
- k. CCITT Recommendation I.464, Multiplexing, Rate Adaption and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability, (1989)
- l. CCITT Recommendation T.35, Procedure for the Allocation of CCITT Member's Codes, (1989)
- m. CCITT Recommendation V.120, Support of an ISDN of Data Terminal Equipment with V-Series Type Interfaces with Provision for Statistical Multiplexing.
- n. CCITT Recommendation V.35, Data Transmission at 48 Kilobits Per Second Using 60-108 kHz Group Band Circuits, (1989)
- o. Military Standard 188-131, Interoperability and Performance Standard for Video Teleconferencing.

8. Abbreviations and Definitions. The abbreviations and definitions contained in this section are for terms contained in this document, and documents referenced by this document.

ANSI	American National Standards Institute
BAS	Bit-Rate Allocation Signal
BCH	Bose-Chaudhuri-Hocquenghem
C&I	Control & Indication
CBP	Coded-Block Pattern
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CIF	Common Intermediate Format
CODEC	Coder/Decoder
CRC	Cyclic Redundancy Check
DCT	Discrete Cosine Transform
ECS	Encryption Control Signal
EOB	End of Block
FAS	Frame Alignment Signal
FAW	Frame Alignment Word
FIL	Loop Filter
FLC	Fixed Length Code
GBSC	Group of Blocks Start Code
GEI	GOB Extra Insertion information
GN	Group Number
GOB	Group of Blocks
GQUANT	GOB Quantizer information
GSPARE	GOB Spare information
HRD	Hypothetical Reference Decoder
HSD	High-Speed Data
IDCT	Inverse Discrete Cosine Transform
INTER	Inter-picture prediction
INTRA	Intrapicture prediction
ISDN	Integrated Services Digital Network
LSD	Low-Speed Data
MB	Macroblock
MBA	Macroblock Address
MBE	Multiple Byte Extension
MC	Motion Compensation
MCU	Multipoint Control Unit
MF	Multiframe
MLP	Multilevel Protocol
MMI	Man-Machine Interface

MPI	Minimum Picture Interval
MQUANT	Macroblock Quantizer
MTYPE	Macroblock Type information
MVD	Motion Vector Data
PEI	Picture Extra Insertion information
PSC	Picture Start Code
PSPARE	Picture Spare information
PTYPE	Picture Type information
QCIF	Quarter-CIF
QUANT	Quantizer
REC	Reconstruction level
SBE	Single Byte Extension
SC	Service Channel
SMF	Sub-Multiframe
TCOEFF	Transform Coefficient
TEA	Terminal Equipment Alarm
TR	Temporal Reference
TS	Time Slot
VLC	Variable Length Code

BAS: *Bit-rate Allocation Signal.* Bit position within the frame structure of H.221 to transmit, e.g., commands, control and indication signals, capabilities.

C&I: End-to-end signalling between terminals consisting of 'control' which causes a state change in the receiver and 'indication' which provides for information as to the functioning of the system, see also H.230.

Data Port: Input/output gate for the user data transmitted within Service Channel or sub-channels according to H.221.

FAS: Frame Alignment Signal. Bit position within the frame structure of H.221 to provide a means to achieve and maintain synchronization between multiple channels, and another system.

In-band Signalling: Signalling via BAS of the H.221 frame structure.

Lip Synchronization: Operation to provide feeling that speaking motion of the displayed person is synchronized with the voice the person makes.

MCU (Multipoint Control Unit): A piece of equipment located in a node of the network or in a terminal which receives several channels from access ports and, according to certain criterions, processes audio-visual signals and distributes them to the connected channels.

MMI: Man-machine interface between user and terminal/system which consists of a physical section (electro-acoustic, electro-optic transducer, keys, ...) and a logical section dealing with functional operation states.

Narrow-band: Bit rates ranging from 56 kb/s to 1,920 kb/s. This channel capacity may be provided as a single B/H0/H11/H12 channel or multiple B/H0 channels in ISDN.

Outband Signalling: Signalling via a channel not being part of the B/H0/H11/H12 channel (due to I.400-Series Recommendations of CCITT).

Visual Telephone Services: A group of audiovisual services including videophone defined in F.721 and videoconferencing to be defined in H.200/AV.112.

9. Objectives. The objective of this standard is to improve the Federal acquisition process by providing Federal departments and agencies a comprehensive, authoritative source for video teleconferencing terminals used in video teleconferencing and videophone applications.

10. Applicability. This standard is intended to assure interoperability among Federal video teleconferencing and videophone systems employing video codecs at rates between 56 kb/s and 1,920 kb/s.

This standard shall be used by all Federal departments and agencies in the design and procurement of video teleconferencing and videophone systems. This standard is mandatory only for those audiovisual systems operating at rates between 56 kb/s and 1,920 kb/s. The standard shall be used in the planning, design, and procurement, including lease and purchase, of all new video communications systems that utilize video codecs.

Recommendation H.261 specifies service from 64 kb/s through 1,920 kb/s, and technically equivalent ANSI standard T1.314-1991 specifies service from 56 kb/s through 1,536 kb/s. To avoid confusion on applications within the Federal Government involving both national and international interoperability, this standard encompasses both ranges of data rates to specify service from 56 kb/s through 1,920 kb/s. It should be noted that most standard data networks in the United States carry data from 56 kb/s to 1,536 kb/s.

In an Integrated Services Digital Network (ISDN), the overall transmission channel may consist of 1 to 6 B (64 kb/s) channels, 1 to 4 HO (384 kb/s) channels, an H10 (1,472 kb/s) channel, or an H11 (1,536 kb/s) channel. The framed video signal can also be carried on other switched or dedicated digital transmission facilities, such as 1 to 6 56 kb/s connections, a DS1 connection, or a fractional DS1 connection.

The technical parameters of this document may be exceeded in order to satisfy certain specific requirements, provided that interoperability is maintained. That is, the capability to incorporate features such as additional standard and nonstandard interfaces is not precluded.

Neither this nor any other standard in high technology field such as telecommunications can be considered complete and ageless. Periodic revisions will be made as required.

The standard is not intended to hasten the obsolescence of equipment currently existing in the Federal inventory; nor is it intended to provide systems engineering or applications guidelines.

11. Specifications. The specifications for this standard are International Telegraph and Telephone Consultative Committee (CCITT) Recommendations H.320, H.221, H.242, H.261, and H.230. The following sections specify the requirements for video teleconferencing and videotelephony terminals.

11.1 Overall Description. Specific requirements for different types of video terminals are defined in CCITT Recommendation H.320. All terminals that meet this standard shall follow the specifications of H.320. Two classes of terminals are defined for Federal use. The specifications defined below are a minimum for each class.

Class 1 terminals are for services that are limited to lower data rates, such as provided by a basic rate ISDN. An example is desk-top video telephone. Terminals acquired for Class 1 applications shall be capable of operation at a minimum of $p=1$ and 2 using QCIF.

Class 2 terminals are for services requiring higher quality than Class 1 such as needed for full video teleconferencing. Terminals acquired for Class 2 applications shall contain the functionality of Class 1 terminals, plus at a minimum, be capable of operation at $p=6$. All Class 2 terminals shall be capable of operation at Full CIF at rates equal to and above $p=2$.

Examples of terminal configurations are given below:

- Class 1 terminal operating over 1 or 2 B channels of an ISDN using QCIF.
- A Class 2 terminal capable of operating using 1-6 B channels of an ISDN using full CIF at rates equal or greater to $p=2$.
- A Class 2 terminal capable of operating using 1 or 2 B channels and a H0 channel. The terminal is capable of operation using full CIF.
- A Class 2 terminal capable of operating using 1 or 2 B channels, an H0 channel, and an H11 channel. The terminal is capable of operation using full CIF.

11.2 Frame Structure. All terminals that meet this standard shall use all the specifications defined in CCITT Recommendation H.221. The H.221 framing structure multiplexes subchannels for audio, video, data, and telematic transmission, as well as in-channel terminal-to-terminal signalling information, within an overall transmission channel of 56 to 1,920 kb/s.

This standard address data channels at nominal bit rates of $p \times 64$ kb/s, where p is an integer that can range from 1 to 30. For unrestricted networks, such as provided by ISDN, each increment of data rate may actually be 64 kb/s, but in restricted networks each increment may be only 56 kb/s. Equipment that meets this standard shall be capable of operating with unrestricted or restricted networks. Restricted networks are discussed in Annex 2 of H.221.

The recommendations which this standard references were designed primarily for use with an ISDN. In an ISDN, the overall transmission channel may consist of 1 to 6 B (64 kb/s) channels, 1 to 4 HO (384 kb/s) channels, an H10 (1,472 kb/s) channel, or an H11 (1,536 kb/s) channel. The framed signals can also be carried on other switched or dedicated digital transmission facilities, such as 1 to 6 56 kb/s connections, a DS1 connection, or a fractional DS1 connection.

11.3 System for Establishing Communication Between Audiovisual Terminals. All terminals that meet this standard shall use all specifications of CCITT Recommendation H.242 for establishing communication between two audiovisual terminals. H.242 describes the in-channel terminal-to-terminal communication control procedures. These procedures allow audiovisual terminals with different capabilities to interwork with each other and with existing telephone equipment. These procedures also allow terminals to switch among compatible modes of operation to support additional applications, for example, sending a facsimile or connecting two personal computers.

11.4 Video Codec. All terminals that meet this standard shall be capable of color and near-full motion operation using, at a minimum, the QCIF format defined in CCITT Recommendation H.261. All terminals shall meet all specifications of H.261. An encoder shall be capable of coding at a minimum average of 6 frames per second. The decoder shall be capable of decoding at least 7.5 frames per second. This is the minimum picture interval and is discussed in H.261, H.221, and H.242. Higher rates can be negotiated using the procedures in H.242.

A terminal is not precluded from using coding algorithms other than H.261, but for every video coding rate the terminal is capable of, the terminal shall be capable of using the H.261 coding algorithm. The purpose of this requirement is to prevent two terminals which are capable of communicating at a high transmission rate such as $p = 24$ having to communicate at $p = 6$ to be interoperable.

Motion Compensation (MC) is optional in the encoder. Motion compensation is required in the decoder, where the reconstruction of the motion is relatively simple. The decoder shall accept one vector per macroblock.

NOTE: The video coding algorithm described in this standard is a variable-rate algorithm. Video transmission is not fixed at multiples of 56 or 64 kb/s, but instead occupies all bandwidth available for video within an overall audiovisual communications system. " $P \times 64$ kb/s" are the nominal transmission rates of the overall system. CCITT Recommendation H.221 provides for operating at multiples of 56 and 64 kb/s.

11.5 Audio Algorithms. This standard does not mandate any audio algorithm, other than those that are mandated in CCITT Recommendation H.320.

NOTE: CCITT Recommendations H.320 and H.221 reference AV.254. AV.254 was a temporary designation used to reference speech coding work at 16 kb/s. Since the approval of H.320 and H.221, AV.254 has been given the designation G.728. Users of this document are advised that at the time of the writing of this document, G.728 has not yet been approved. The intended use for G.728 is for video teleconferencing terminals operating at a low transmission rate such as the Class 1 terminals specified in this document.

11.6 Frame-Synchronous Control and Indication Signals for Audiovisual Systems. All terminals that meet this standard shall use CCITT Recommendation H.230. H.230 provides additional frame-synchronous control and indication signals such as freeze picture, video loopback, and simple multipoint

controls. These control and indication signals are necessary to provide additional functionality and to provide extensibility to future standards.

12. Implementation. The use of this standard by Federal departments and agencies is compulsory and binding for the acquisition of new equipment and services, effective June 1, 1993, except as noted in Section 10.

13. Conflict with Referenced Documents. Where the requirements stated in this standard conflict with any requirements in the referenced specifications, the requirements of this standard shall apply. The nature of the conflict between this standard and the referenced specifications shall be submitted in duplicate to the Director, Computer Systems Laboratory, Technology Building, Room B-154, National Institute of Standards and Technology, Gaithersburg, MD 20899.

14. Waivers. Under certain exceptional circumstances, the heads of Federal departments and agencies may approve waivers to Federal Information Processing Standards (FIPS). The head of such an agency may redelegate such authority only to a senior official designated pursuant to section 3506(b) of Title 44, U.S. Code. Waivers shall be granted only when:

- a. Compliance with a standard would adversely affect the accomplishment of the mission of an operator of a Federal computer system or related telecommunications system, or
- b. Cause a major adverse financial impact on the operator which is not offset by Governmentwide savings.

Agency heads may act upon a written waiver request containing the information detailed above. Agency heads may also act without a written waiver request when they determine that conditions for meeting the standard cannot be met. Agency heads may approve waivers only by a written decision which explains the basis on which the agency head made the required finding(s). A copy of each such decision, with procurement sensitive or classified portions clearly identified, shall be sent to: National Institute of Standards and Technology; ATTN: FIPS Waiver Decisions, Technology Building, Room B-154; Gaithersburg, MD 20899.

In addition, notice of each waiver granted and each delegation of authority to approve waivers shall be sent promptly to the Committee on Government Operations of the House of Representatives and the Committee on Governmental Affairs of the Senate and shall be published promptly in the *Federal Register*.

When the determination on a waiver applies to the procurement of equipment and/or services, a notice of the waiver determination must be published in the *Commerce Business Daily* as a part of the notice of solicitation for offers of an acquisition or, if the waiver determination is made after that notice is published, by amendment to such notice.

A copy of the waiver, any supporting documents, the document approving the waiver and any supporting and accompanying documents, with such deletions as the agency is authorized and decides to make under 5 U.S.C. Sec. 552(b), shall be part of the procurement documentation and retained by the agency.

15. Where to Obtain Copies. Copies of this publication including CCITT Recommendations H.320, H.221, H.242, H.261, and H.230 are for sale by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. When ordering, refer to Federal Information Processing Standards Publication 178 (FIPSPUB178), and title. Payment may be made by check, money order, purchase order, credit card, or deposit account.

In addition, CCITT Series H Recommendations are available individually from NTIS. When ordering, specify:

- H.221-1990 - PB93-979101
- H.230-1990 - PB93-979102
- H.242-1990 - PB93-979103
- H.261-1990 - PB93-979104
- H.320-1990 - PB93-979105

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